Qualcomm

November 30, 2021

Marlene Dortch
Secretary
Federal Communications Commission
45 L Street, NE
Washington, DC 20554

> **Re: Qualcomm Incorporated Application to be Authorized as 6 GHz Band**
> **Automated Frequency Coordination System Operator;**
> **ET Docket No. 21-352**

Dear Ms. Dortch:

Qualcomm Incorporated respectfully submits the enclosed application to be authorized as an Automated Frequency Coordination system operator.

Please contact the undersigned with any questions relating to this submission.

Respectfully submitted,

Aspasia A. Paroutsas
Vice President, Federal Regulatory Affairs

Att.

Qualcomm Automated Frequency Coordination System Operator Proposal

ET Docket No. 21-352

Nov. 30, 2021

Introduction

Qualcomm is pleased to submit this application to become an Automated Frequency Coordination ("AFC") system operator enabling standard power unlicensed operations outdoors and indoors in the 6 GHz unlicensed band.[1] Qualcomm's responses to the information requested by the Commission in its September 28, 2021, Public Notice are provided below.

Qualcomm is a world leading wireless innovator that has developed the foundational technologies that have been fueling the mobile broadband revolution. Qualcomm is very excited by the ability to support standard power unlicensed Wi-Fi and 5G NR-Unlicensed 6 GHz band solutions that will help enable a technology transformation impacting every kind of connected device — from mesh networks and fixed wireless systems to smartphones and the ever-increasing Internet of Things. From homes and businesses to school campuses and libraries to stadiums and airport lounges, our Wi-Fi solutions build on Qualcomm's world-class engineering capabilities to connect users and devices with wireless advancements that deliver gigabit speeds, low-latency, and broad coverage needed for immersive, high-performance user experiences.

Qualcomm Responses to FCC Questions:

Question 1. AFC system operator contact information, including name, phone number and email address that Commission staff may use for all AFC system related inquiries, such as information and data requests or to provide enforcement instructions.

AFC related inquiries can be addressed to the following individuals:

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[1] This application is consistent with the requirements in FCC Rule Section 15.407(k), (l) & (m), *see* 47 C.F.R. § 15.407(k), (l) & (m), and the FCC's 6 GHz Report and Order. *See Unlicensed Use of the 6 GHz Band*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd. 3852 (2020).

- Technical Inquiries:

  - Tevfik Yucek, Principal Engineer, 408-652-1053, tyucek@qti.qualcomm.com

  - John Forrester, Sr. Director of Engineering, 858-845-7428, jforrest@qti.qualcomm.com

- Legal Inquiries:

  - John Kuzin, Vice President of Spectrum Policy and Regulatory Counsel, 202-489-9905, jkuzin@qualcomm.com

  - Aspa Paroutsas, Vice President of Federal Regulatory Affairs, 202-277-9444, aspa@qualcomm.com

- Product Line Inquiries

  - Vivek Sinha, Director of Product Management, 408-652-0373, sinhav@qti.qualcomm.com

Question 2. A technical diagram showing the architecture of the AFC system with a brief description of its operation.

The below technical diagram depicts the high-level components of our AFC system architecture.
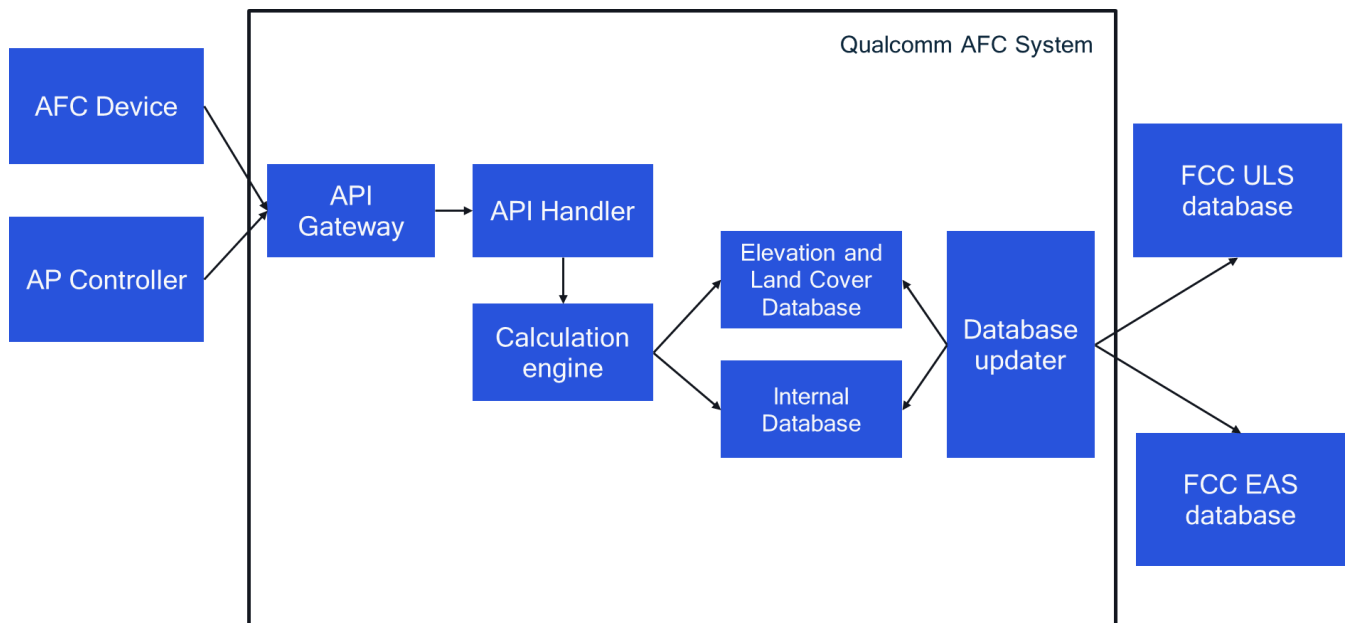
The Qualcomm AFC system supports the Wi-Fi Alliance "AFC System to AFC Device Interface Specification," which defines an open API for AFC-enabled standard power unlicensed devices to communicate with the AFC

system. By supporting this API, Qualcomm's AFC system can work with any AFC-enabled standard power unlicensed device that supports the WFA specification. API requests are handled by the API gateway and API Hander blocks.

At the heart of the Qualcomm AFC system lies the AFC "Calculation engine" which determines channel and power availability based on the current 6 GHz licensed incumbent information in the FCC Universal Licensing System (ULS) database. The calculation engine downloads ULS data from FCC website on a daily basis, in compliance with FCC rules, and stores the required and necessary information after parsing the licensed incumbent ULS data. When an AFC system spectrum availability inquiry is received, the calculation engine calculates the maximum power that the AFC device can transmit on a given available channel while making sure the received signal level at the incumbent system stays 6 dB below its noise floor. These calculations are completed based on the methods described in the answer to Question 3 below. The calculation engine also disables channels when the location of the inquiry is within the exclusion zone of one of the Radio Astronomy sites as defined in the Part 15 rules 47 C.F.R. § 15.407(m).

The Qualcomm AFC system uses USGS National Elevation data in 1 arcsecond resolution; this elevation data is used for calculating antenna offset angles and for ITM propagation loss. Our AFC system uses USGS National Land Cover Data (NLCD) with 1 arcsecond resolution. NLCD data is used for region determination (URBAN, SUBURBAN and RURAL).

Question 3. A description of whether the AFC system software is based on a propriety implementation or open source.

The Qualcomm AFC system software is based on a propriety implementation of an industry-developed AFC standard. Specifically, the implementation is based on the Wireless Innovation Forum's (WinnForum) working document WINNF-TS-1014 "Functional Requirements for the U.S. 6 GHz Band under the Control of an AFC System." However, some components, either in the AFC calculation engine or in the other parts of AFC cloud implementation, use open-source libraries when available.

WINNF-TS-1014 defines the functional requirements for the AFC System and AFC System Operator. Various aspects of AFC system implementation are standardized in WINNF-TS-1014, such as how missing ULS parameters should be determined, how to model FS antennas, and details of pathloss calculations and registration requirements. The WINNF-TS-1014 currently is in draft form and expected to be completed in early 2022. When it is finalized, Qualcomm plans to comply with this specification. Furthermore, the Wi-Fi Alliance (WFA) is working on a test plan for AFC systems and will define certain AFC parameters. Qualcomm plans to comply with the requirements of the WFA AFC system test plan and test vectors defined in the context of this test plan. In the event there is a conflict between WFA and WinnForum parameters, Qualcomm plans to follow WFA guidance. At all times, the Qualcomm AFC system will comply with the FCC's rules and regulations and any subsequent guidance.

Question 4. A demonstration that the prospective AFC system operator possesses sufficient technical expertise to operate an AFC system.

Qualcomm has developed both hardware and software for highly robust and high-performance wireless communications systems for several decades that support billions of mobile devices in use today. Qualcomm has designed a fully functional AFC system that operates in accordance with FCC regulations and current draft industry standards and has a sizeable staff of software engineers assigned to develop, deploy, and maintain Qualcomm's AFC system. Our company's engineering teams provide software engineering solutions to support wireless connectivity via implementing multiple layers of the software stack, including user space and kernel space in a range of software and hardware operating environments.

Qualcomm possesses long standing expertise in the operation of carrier grade wireless network management systems. One key example is the Qualcomm GNSS Assistance service, which provisions assistance data for GPS and other GNSS constellations to over 1.5 billion devices on a periodic basis. This GPS and other GNSS assistance data have a validity time measured in days. This Qualcomm-managed service has been in operation since 2007. Another example is the Qualcomm Global Terrestrial Positioning service that is mostly used for IoT, with global coverage and a database of 63 million cell towers and 1.5 billion Wi-Fi access points.

Question 5. A description of the prospective AFC system operator's recordkeeping policies, including registration record retention as well as retention of historical frequency availability data.

Qualcomm's AFC system uses a combination of parameters to create a unique device ID for each device that seeks to communicate with the AFC system. This provides Qualcomm's AFC System with an ability to uniquely identify each standard power unlicensed device. In conjunction with this unique device ID there is an HTTPS Pairing Application Programming Interface (API) that provides a secure means through which the AFC device is onboarded to Qualcomm's AFC system. The Pairing API also provides a service to obtain an authentication token for access to Qualcomm's AFC system. This token has embedded registration information to uniquely identify the AFC device when the device queries Qualcomm's AFC system API. This mechanism enables Qualcomm to identify the requests from specific registered AFC devices and store relevant data relating to each specific AFC query.

For AFC device requests that are deemed valid, the Qualcomm AFC system will retain the required information specified in the applicable Part 15 rules, e.g., 47 C.F.R. § 15.407(k), that govern AFC operator requirements for the required duration. Specifically, we retain the following information which may be provided to FCC upon request:

- Device Serial No
- Unique Request ID
- Device FCC ID
- Inquired Lower frequency
- Inquired High frequency
- Minimum Desired Power
- Inquired Location (with uncertainty)

<u>Question 6. A description of how the prospective AFC system operator will handle unanticipated situations that may disrupt performance of the system's required functions—ranging from exceptional cases that affect the system's ability to perform its required functions in isolated instances to cases involving the type of widespread disruption that an event like a system failure might cause.</u>

Qualcomm's AFC system is designed with fault tolerance in front of mind. There are two aspects involved here, the resiliency of infrastructure and the resiliency of the AFC Service. For cloud infrastructure, Qualcomm's AFC system plans to use an existing cloud infrastructure provider.

Infrastructure Resiliency:

- Qualcomm's AFC system will take advantage of resiliency provided by state-of-the-art cloud infrastructure providers. These selected vendors have infrastructure uptime of 99.99% and provide the backbone of today's internet.

- Additionally, Qualcomm's AFC system will be deployed in multiple geographical regions. Each region will have its own fully-functional infrastructure, which additionally provides physical separation and quick migration in the event of natural disasters in certain geographic areas.

- Qualcomm's AFC system is also designed to scale up or down based on the demand and requests for the AFC system. This provides dynamic load balancing and the ability to serve a surge in API requests.

AFC System Resiliency:

- Qualcomm's AFC system is designed on a widely used open-source REST API platform which services as a basis for hundreds of services offered by different web services companies. This provides a vetted resiliency of the core AFC system infrastructure.

- Qualcomm's AFC system additionally leverages best practices from cloud infrastructure providers in terms of data management, security, load balancing, and robustness.

- Qualcomm's AFC algorithm is designed pursuant to the company's best practices in software management, with all the code being peer reviewed with error handling to satisfy any unforeseen scenarios. In addition, the Qualcomm AFC System is internally stress tested to continuously support a very high degree of resiliency.

Question 7. A description of the methods (e.g., interfaces, protocols) that will be used for secure communication between the AFC system and its associated standard-power devices and to ensure that unauthorized parties cannot access or alter the database or the list of available frequencies and power levels sent to the standard-power devices.

Data Center and Physical Security:

The Qualcomm AFC System uses state of the art public cloud hosting infrastructure. The public cloud hosting provides highly secure Data Center and Physical Security, which is outlined in the links provided below:

1. https://aws.amazon.com/compliance/data-center/controls/

2. https://cloud.google.com/security

Transport Layer Security (TLS):

The Qualcomm AFC System uses TLS as specified in Section 3.4.2 of the Wi-Fi Alliance "AFC System to AFC Device Interface Specification." The use of TLS protects the data being exchanged between the AFC Device and the AFC System against eavesdropping, man-in-the-middle, and other cyber attacks.

Secure Tokens for Access via Web APIs:

The Qualcomm AFC System also implements a way for AFC Devices to obtain an Authorization Token that allows invocation of the AFC System Web API. The token mechanism allows for the AFC System to revoke tokens from devices deemed malicious or those attempting to use multiple locations by spoofing Device Serial Number

Only the algorithm that returns available frequencies and power levels to the standard-power devices has read access to the database.

Question 8. If the prospective AFC system operator will not be performing all AFC functions, information on (1) the entities that will be responsible for operating other functions of the AFC system; and (2) how the Commission can ensure that all of the requirements for AFC systems in the rules are satisfied when AFC functions are divided among multiple entities.

The Qualcomm AFC solution will provide all AFC functions including (1) Registration, (2) ULS database, (3) Security/Authentication, and (4) Calculation engine.

Question 9. A description of how the prospective AFC system operator will provide access to their AFC system for a public trial period which will include thorough testing.

The Qualcomm AFC System will provide access to a secure Web API. The interested parties will be provided instructions on how to connect with the Qualcomm AFC System and will be able to send spectrum inquiries and receive responses using Wi-Fi Alliance "AFC System to AFC Device Interface Specification".

Instructions to access the Qualcomm AFC System can be requested by contacting the people listed in the response to Question 1 above.

Question 10. An affirmation that the prospective AFC system operator, and any entities responsible for operating other functions of the AFC system under the control of the AFC system operator, will comply with all of the applicable rules as well as applicable enforcement mechanisms and procedures.

Qualcomm hereby affirms that it will comply with all applicable Commission rules regarding AFC system operation and applicable enforcement mechanisms and procedures.